COMMAND AND CONTROL OF AIRPOWER--
A NEW PARADIGM FOR THE FUTURE

BY
COLONEL GREGORY S. MARZOLF

A STUDY PRESENTED TO THE FACULTY OF
THE AIR WAR COLLEGE
FOR COMPLETION OF GRADUATION REQUIREMENTS

AIR WAR COLLEGE
AIR UNIVERSITY
MAXWELL AIR FORCE BASE, ALABAMA
FEBRUARY 2009

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
FEB 2009	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Command and Control of Airpower--A New Paradigm for the Future	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air War College, Maxwell Air Force Base, Alabama**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**58**	

DISCLAIMER

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

ABOUT THE AUTHOR

Colonel Gregory S. Marzolf was commissioned through the Air Force Reserve Officer Training Corps (ROTC), University of Tennessee, in June 1988. He entered active duty as a student pilot in the Euro-NATO Joint-Jet Pilot Training Program at Sheppard AFB, Texas, earning a follow-on assignment to Luke AFB, Arizona to fly the F-16 Fighting Falcon. After this, Col Marzolf then spent the next 4 years flying the F-16 at Osan AB, Republic of Korea and Spangdahlem AB, Germany. While in Germany, he flew and led 56 combat missions in Operations Northern Watch and Deny Flight. Leaving Germany in 1995 for Cannon AFB, New Mexico, he helped the 522nd Fighter Squadron transition from F-111's to F-16's and, after a short time, left to attend the United States Air Force Weapons Instructor Course (WIC) at Nellis AFB, Nevada. Returning to Cannon AFB in June 1996, he served as Chief of Weapons in the 523rd Fighter Squadron. Following this tour in 1998, he returned to WIC as a weapons instructor. He left Nellis AFB in 2000 to attend the Air Command and Staff College (ACSC) and the School of Advanced Airpower Studies (SAAS). Completing the schools in 2002, Col Marzolf was assigned to the Air Staff at the Pentagon, and then departed in 2004 for Hill AFB, Utah where he was the 388th Fighter Wing's Chief of Safety and the Director of Operations for the 421st Fighter Squadron. He left Hill AFB in 2006 to command the 64th Aggressor Squadron at Nellis AFB. Completing squadron command in 2008, Col Marzolf served as the 57th Adversary Tactics Group Deputy Commander until leaving for his present assignment at the Air War College.

ACKNOWLEDGEMENTS

I would like to acknowledge several people that were instrumental in helping me complete this study. Major General Stephen Hoog deserves full credit for providing the motivation and advice to generate an in-depth study on this subject. In addition, Group Captain Raymond Goodall was momentous helping me flush out the topic and ensure it remained on track. Lastly, Colonel Ronald "Grumpy" Sanders was an immense help by providing insight into other command and control efforts to make airpower better for the joint force. Thank you all very much.

In addition, I want to thank my wife, Carole, and our four children for their loving support. They always helped keep me focused on the project—even when it was to their detriment. To them, this study is dedicated.

ABSTRACT

Recent experiences in Operations Iraqi Freedom and Enduring Freedom have highlighted the need for adaptable and tailorable airpower command and control (C2) systems that can better serve the joint force across the entire range of operations. Though the Air Force has done a good job adapting adapt the existing C2 system to the task, at times using a variety of control frameworks, it has not yet looked at future C2 requirements holistically in order to create a "toolbox of capabilities" that avoids the need for poorly optimized piece-meal or work-around solutions. Simply stated, as battlefield dynamics change and technology moves forward, air employment and its associated C2 systems must also change to remain relevant. The inattention has resulted in obsolete elements of the Theater Air Command System, Air Operations Centers funded at 50 percent (or less), poor command relationships, and an unwieldy C2 structure that is difficult to tailor for today's fight. Here, decentralized ground operations are bypassing operational-level planning processes. This has created a large seam between air planning (that occurs centrally at the AOC, far removed from the battlefield) and ground planning that occurs at low-level tactical units (directly on the battlefield). The upshot is a perception that the Air Force is not there, or not fully committed to the joint fight. To help solve these problems, this study offers insights into the world of C2 by explaining that there are no "one size fits all" C2 systems. It stresses the importance of human relationships to build trust. It emphasizes the benefits of hierarchal over flat structures. And, it offers some suggestions (such as using mission-type orders) to help overcome bandwidth limitations and C2 vulnerabilities in order to create a more survivable C2 system. After this, the paper suggests that the Air Force's current "centralized control, decentralized execution" paradigm does not adequately represent airpower employment, and because of this, it redefines and offers a new C2 paradigm, "centralized command, adaptive control, decentralized execution." This paradigm better represents the future evolution and totality of airpower employment. In the end, the following suggestions are offered to make future airpower C2 better and more relevant. They include: 1) Adopt "Centralized Command, Adaptive Control, Decentralized Execution" as the AF's paradigm for airpower employment. 2) Develop more flexible/adaptable C2 solutions that provide the JFACC with a "toolbox of capabilities;" this not only includes fixing TACS, but also having structures/C2 elements that provide sufficient depth of control. 3) Consider adopting MTO as an over-arching C2 philosophy for AF base-line training. 4) Implement an Air Warfare Training Strategy. 5) Build strong habitual command relationships by avoiding overly flat C2 structures that increase span of control, increasing centralized decision-making, and allowing subordinates to drift. 6) Reduce CENTCOM's CFACC duties so they can focus exclusively on warfighting, not on other service-related matters that detract from the joint mission. 7) Build a deployable (or partly deployable) AOC capability. 8) Extend appropriate AF deployments to one-year. 9) Ensure forces train together before deploying into combat. And, 10) build a career track to help embolden AF warfighting culture.

CONTENTS

Chapter 1

Introduction

"Thus, airpower in its (sic) current formulation seems to have become no more nor less than the power of detached, dispassionate technology."
— Anonymous Senior Air Force Officer

While the above statement might seem aloof, it does exhibit a degree of truth. The Air Force has been trying to fill technological gaps and streamline processes for some time. This was most evident under General John Jumper's watch as Chief of Staff when he continually strove to breakdown stovepipes in order to create a "system of systems" architecture. He realized that without the proper integration of man, machine, and accurate, timely information, airpower could never reach its full potential. Achieving Gen Jumper's nexus, however, has not been easy. Precise weapons require precise information, and taken against the backdrop of an adaptable enemy that blends into the environment making them difficult to locate and identify, along with stringent political restrictions that necessitate limited collateral damage, the situation quickly becomes complex. Because of these complexities, the Air Force has spent much time and effort developing resources to deal with them. One major effort is in the area of command and control (C2). C2 provides the critical links and processes that turn individual pieces into a capable array needed to achieve synergistic effects on the battlefield. To do this, the Air Force developed a C2 system centered on the Joint Air Operations Center (JAOC) and commanded by a Joint Force Air Component Commander (JFACC).[1]

The JFACC/JAOC concept was fully brought to fruition in the 1991 Gulf War when Lieutenant General Charles Horner served as the first CFACC using the Tactical Air Command

[1] The JFACC is appointed by the Joint Force Commander (JFC) and is responsible for the employment of airpower in a given operation or across an entire theater. Joint Doctrine stipulates the JFACC will be called the Combined Force Air Component Commander (CFACC) when coalition forces are participating in the operation. Likewise, the JAOC becomes the Combined Air Operations Center (CAOC) in similar situations.

Center (TACC) to control theater-wide air assets.[2] Many airmen considered this a watershed event as they had long advocated for it since Operation Torch in World War II, and the Vietnam War only served to embolden their resolve when route packs unduly restricted the full integration and employment of airpower.[3] The Gulf War, then, validated a concept long held as sacrosanct. As evidenced in the war, and as correctly noted in the Gulf War Air Power Survey, the CFACC concept was rated as an overwhelming success.[4]

With the validation complete, the Air Force worked vigorously to fully implement the C2 framework into practice and doctrine. In 2000, Gen Ryan, the Air Force's Chief of Staff, declared the Air Operations Center (AOC) a weapons system, which required the Air Force to man and equip five Falconer AOCs located across the world to support joint forces.[5] Because conducting major combat operations (MCO) are the most complex, the AOCs were designed with the capacity to execute over 2,000 sorties per day. Although AOCs and their C2 infrastructures have succeeded in supporting many large-scale joint operations such as Operations Deliberate Force, Allied Force, Enduring Freedom, and Iraqi Freedom, the C2 system needs to evolve to the next higher level so it can better support smaller decentralized operations like those occurring today in Iraq and Afghanistan.[6]

The problem largely stems from decentralized ground forces that are bypassing operational-level planning processes. This has created a large seam between air planning (that occurs centrally at the AOC, far removed from the battlefield) and ground planning that occurs at

[2] The TACC was the precursor to today's JAOC.
[3] In Operation Torch, aircraft were directly assigned to individual ground units. This stunted airpower's ability to adapt to and focus effort onto the battlefield where most needed. In essence, aircraft not used by one ground unit could not help support another ground unit.
[4] Eliot Cohen, *Gulf War Air Power Survey*, Summary Report (Washington, D.C.: US Government Printing Office, 1993), 159-161.
[5] The five AOCs serve Central Command (CENTCOM), Pacific Command (PACCOM), Southern Command (SOUTHCOM), European Command (EUCOM), and US Forces Korea (USFK).
[6] "Integration of Airpower in Operational Level Planning Report," USAF/A9 Lessons Learned Report, 6.

low-level tactical units (directly on the battlefield). While some might attribute the seam's existence as only applying to the current fight, future joint employment concepts suggest ground forces will not only continue to fight decentralized, but decentralize even more.[7]

To the Air Force's credit, it has taken steps to meet the joint force's needs by adapting C2 processes to handle the task. Here, C2 processes were altered to better support Irregular Warfare (IW), including police and law enforcement-like operations that are taking place in Iraq and Afghanistan. IW is different than traditional combat and requires more adaptable and persistent approaches. For example, even during the major combat operations (MCO) phase of Operation Iraqi Freedom (OIF), the Air Force was adaptive by using centralized control in west Iraq to support Special Ops teams, directive control for operations in downtown Baghdad, and a more traditional C2 approach using an Air Support Operations Center (ASOC) to execute missions in southern Iraq.[8] In short, the Air Force has made tremendous gains in this area.

Having said that, the Air Force has not yet fully fleshed-out the evolving C2 requirements for future operations. As will be shown in this paper, future operations will likely require a holistic approach to airpower C2, one that requires more than adapting old equipment with outdated concepts. In fact, system work-arounds used to meet today's requirements have been largely exhausted, and the Air Force's C2 infrastructure struggles from a lack of manning and equipment. Though more manning and equipment will help, what is more important is the realization that as battlefield dynamics change and technology moves forward, air employment and its associated C2 systems must also change by design to remain relevant. This paper seeks to correct this deficiency.

In addition, because the JFACC/JAOC C2 structure is highly centralized, it presents the

[7] Gen Gary Luck and Mike Findlay. "Joint Operations Insights and Best Practices." 2nd ed. (Norfolk, VA: US Joint Forces Command, 2008), 3.
[8] Maj Gen Hoog, telephone interview, 9 Jan 2009.

enemy with a lucrative target. If an attack was successful, it could decapitate the JFACC and render the C2 of airpower largely impotent. If the Air Force does not also address this problem, the joint force may be left with a C2 system that cannot overcome the trials of combat.

In offering solutions, this paper seeks to formulate a new paradigm for airpower C2. To accomplish this, the paper begins by offering C2 insights that provide a solid foundation to develop the new paradigm. The insights suggest that more flexible and adaptable C2 solutions are needed to allow the JFACC to create a tailored C2 system to meet mission requirements. These solutions better serve the joint force across the full range of military operations. In addition, the paper provides insight on how to make the C2 system more resilient to enemy attack and require less bandwidth. Last, the paper investigates human aspects of C2. This includes the need to form habitual command relationships to develop trust, responsibility, and accountability – the required cornerstones for any C2 system work.

To formulate the new paradigm and find solutions, research was accomplished to determine C2 requirements. This was largely done by dissecting the wealth of information currently available from service documents, joint force articles, after-action reports from past and current conflicts, and documents published by unified command staffs—particularly Central Command (CENTCOM). After this, research was conducted to determine what C2 architectures were best suited to meeting the joint forces' needs. This was largely done by reading *Command in War* by Martin van Creveld, *Command in Air War* by Lt Colonel Michael Kometer, and *the Human in Command* by Carol McCann and Ross Pigeau. Primary and secondary sources were used when available, and when information conflicted, the most current source was prioritized. In other cases, interviews were conducted in order to obtain better insight into the problem. In the end, all information was collected, categorized, and then presented in this paper.

This study is divided into three chapters. Chapter 1 is the introduction. Chapter 2, C2 Insights, provides the necessary groundwork to understand what is needed to solve some of today's C2 problems. Specifically, it begins by addressing why there are no "one size fits all" C2 structures, and the associated C2 challenges that exist within this context. Second, it highlights how human relationships, trust, and accountability play-out in C2 systems. Third, it investigates flat verses hierarchal C2 structures and offers suggestions on how best to proceed. And last, it sheds light on how to overcome vulnerabilities and bandwidth problems so that the system keeps working (or at least degrades gracefully) when attacked.

Chapter 3 takes the long-standing "centralized control, decentralized execution" paradigm and redefines it into a new C2 paradigm—"Centralized Command, Adaptive Control, Decentralized Execution"—that better represents the totality of airpower and future C2 requirements. Suggestions are then made on how the Air Force might incorporate the new paradigm in the future.

Chapter 2

Command and Control Insights

"When all you have is a hammer, all of your problems look like nails."
— Anonymous

As discussed in Chapter 1, the Air Force's current C2 system was built to conduct major combat operations (MCO).[9] Though this C2 framework has served the joint force well and has been modified to work in conflicts other than MCO, today's decentralized ground fights in Iraq and Afghanistan along with evolving battlefield dynamics and technology suggest a more flexible and pragmatic approach is needed—an approach that works across the entire range of military operations—for today and tomorrow. With this in mind, the anonymous statement above only serves to highlight the need for more flexible and adaptable C2 systems that uphold Martin Van Creveld's assertion that there are no "one size fits all" C2 systems.[10] This chapter begins by explaining why Creveld's assertion is true and explains why future C2 solutions must provide the JFACC with a "toolbox of capabilities." The chapter then highlights the need for commanders to develop habitual relationships to build trust, responsibility, and accountability throughout the C2 chain—suggesting that any C2 system that does not put human relationships first is inherently problematic. After this, flat C2 organizational structures are investigated to determine if they are more effective than traditional hierarchal frameworks. Finally, bandwidth and vulnerability are addressed. The chapter concludes with a brief summary of its findings.

There Are No "One Size Fits All" C2 Systems

When it comes to airpower, there are many reasons why no "one size fits all" C2 systems

[9] Major operations and campaigns involve large-scale combat where the goal is to quickly prevail and cease hostilities as soon as possible after having achieved favorable conditions. Joint Publication 1, 14 May 2007, n.p.
[10] Martin Van Creveld, *Command in War* (Boston, MA: Harvard University Press, 1985), 9, 262.

exist. Three of these reasons include: 1) strategy and policy, 2) different missions and command frameworks, and 3) different conflicts.

Strategy and Policy

Carl von Clausewitz stated that war is the continuation of politics, by other means.[11] This is to say that when it comes to applying force, policy comes first with the military (and all other instruments of power) remaining subordinate. If this were not the case, it would be akin to putting the horse before the cart where the military would largely exist only to serve itself. This is not to say that policy makers should operate in a vacuum and disregard military leader's advice. If they were to do so, political leaders might ask the military to perform in ways not doable, leaving a wide gap between political desire and reality. Samuel Huntington suggested that policy makers should have a basic respect and understanding for what the military provides—and to avoid micromanaging the details.[12] Eliot Cohen reemphasized this point by asserting that while civilians should make the war, the military should run it. He went on to suggest that the two factions must continually work together to harmonize ends, ways and means through rigorous and frequent dialogue.[13] This, he asserted, was absolutely essential to achieving success. General Gary Luck re-emphasized this point as essential in successfully winning today's wars.[14] Because of this "back-and-forth" dialogue, the military must conform and adapt to dynamically changing political demands. A few examples help illustrate this point.

During Operation Desert Storm, President George H. Bush provided military leaders with broad guidance to fight the war. The underpinning philosophy was to strike a balance between

---

[11] Carl von Clausewitz, *On* War (Princeton, N.J.: Princeton University Press, 1976), 605.

[12] Samuel P. Huntington, *The Soldier and the State: The Theory and Politics of Civil-Military Relations* (New York, NY: Vintage Books, 1964), 80-85.

[13] Lt Col Michael W. Kometer, *Command in Air War* (Maxwell AFB, AL: Air University Press, 2007), 8

[14] In his document, "Joint Force Insights and Best Practices," Gen Luck found that continuous interaction between the military and political officials have been vital to achieving recent combat success. Gen Gary Luck and Mike Findlay. "Joint Operations Insights and Best Practices," 3.

political and military decision-making in order to avoid the mistakes of the Vietnam War.[15] With broad guidance given to military leaders, the balance quickly shifted towards policy when Iraqi scuds threatened to dissolve the coalition. Here, President Bush took action by not only reassuring Israeli leaders, but also giving direct guidance to his military commanders. He also became more involved after the Al Firdos bunker bombing that killed over 150 innocent women and children.[16] Later during the battle of Khafji where coalition forces were shown annihilating Iraqi forces, President Bush again intervened as political pressure mounted—pressure that eventually brought him to terminate the war.[17] In each of these cases, President Bush's increased political involvement required military leaders to alter their C2 process by changing the level of decision-making authority (i.e., the level where decision-making occurred).[18] A similar situation occurred in Operation Allied Force (OAF).

During OAF, the political-military balance was skewed as political demands largely overran military strategy—to the point where military leaders focused more on keeping compliance with political constraints than on winning the war.[19] Instead of having a back-and-forth dialogue on strategy, a target approval process was implemented that ensured the military complied with policy.[20] This included tight rules of engagement (ROE) that, on many occasions, required higher headquarters to make tactical-level decisions.[21] This created a tightly coupled C2 system focused more on obeying specific constraints and avoiding specific actions than on

[15] In the Vietnam War, President Lyndon Johnson handpicked targets during his Tuesday luncheons. Because of his direct involvement, many feel that the military was not given enough freedom to fully prosecute the war. They go on to assert that this was a leading cause for America's loss.
[16] After the Al Firdos bunker bombing fiasco, political pressure convinced General Schwarzkopf, the JFC, to effectively halt bombing on Baghdad. Lt Col Michael Kometer, *Command in Air War*, 260.
[17] Perry D. Jamieson, *Lucrative Targets* (Washington, DC: US Government Printing Office, 2001), 97-106.
[18] A commander inhibits lower-level action by raising decision-making approval authority higher. This makes subordinates get approval from higher authorities before they act. Conversely, commanders can empower lower-level forces to act by lowering authority levels.
[19] Lt Gen Michael C. Short, Address, Air War College, Maxwell AFB, AL, 6 November 2008.
[20] Lt Col Michael Kometer, *Command in Air War*, 108
[21] Ibid., 208.

executing and assessing airpower's effects on the enemy.[22] Here, like in Desert Storm, political constraints necessitated military leaders to adjust their C2 framework.

These two examples are but a few that led Lt Col Michael Kometer to conclude in his book, *Command in Air War*, that when political decision makers impose constraints on specific actions, military leaders have less authority to delegate actions to subordinate commanders.[23] This is to say that when the political/military balance becomes lop-sided towards policy, military leaders have little choice but to obey, sometimes requiring centralized decision-making at high levels. Likewise, when political leaders empowered senior military leaders, they had the freedom to delegate their authority to lower levels. In the end, neither approach is right or wrong as political necessity determines the context. Instead, military commanders must have flexible and adaptable C2 systems to tailor operations to political demands.

Different Missions and Command Frameworks

Different missions and command frameworks also require adaptive and flexible C2 systems. This is best illustrated by examining nuclear employment, strategic air warfare, and close air support (CAS) missions.[24] For nuclear missions, extremely rigid and robust C2 systems are needed to ensure the weapons are used on the proper targets, at the proper times, and only when authorized. Because the consequences of improper nuclear weapons use are extremely

[22] Coupling is the degree of oversight and interaction within a C2 system and defines the amount of impact the actions of one part of an organization has on another. Loosely coupled systems are more independent, less rigid, have less oversight, and allow subordinates more freedom to act and innovate. Tightly coupled systems are more dependent and allow subordinates freedom to act and innovate. Accordingly, it requires more oversight and procedures to ensure subordinates comply. With complex systems, tight coupling is difficult to achieve with centralized control due to the vast amounts of variables. In such systems, decentralized control with sufficient depth is a better approach. Lt Col Michael Kometer, *Command in Air War*, 74.

[23] Ibid., 78.

[24] Strategic air warfare is defined as "air combat and supporting operations designed to effect, through the systematic application of force to a selected series of vital targets, the progressive destruction and disintegration of the enemy's war- making capacity to a point where the enemy no longer retains the ability or the will to wage war. Vital targets may include key manufacturing systems, sources of raw material, critical material, stockpiles, power systems, transportation systems, communication facilities, concentration of uncommitted elements of enemy armed forces, key agricultural areas, and other such target systems." Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms*, 12 April 2001, n.p.

high, control mechanisms are highly centralized with hardened and redundant communications systems to ensure the system remains intact.

While nuclear missions require a high degree of centralization, strategic air warfare missions require a high degree of centralized planning with more decentralized control at lower levels to allow operational and tactical-level decision makers the freedom to overcome unforeseen enemy actions as the battle unfolds. Here, centralized planning ensures unity of effort by harmonizing and integrating airpower across the battlespace. Without centralized planning and a decentralized C2 structure, achieving satisfactory outcomes and effects would be difficult if not impossible.

CAS, the third mission, requires even more decentralization. Because this mission contains a high degree of uncertainty that makes it practically impossible to know the target in advance, a decentralized C2 system is needed where tactical-level decision makers (e.g., pilots and ground-based controllers) are given mission-type orders (MTOs) that specify commander's intent.[25] Unlike strategic air warfare where pilots are given the target's location, time-on-target, and many other mission details, pilots conducting CAS are told "what to target" and "where to engage" after talking with control agencies after takeoff. In the end, this mission requires tactical-level decision makers to have a high degree of freedom to decide how best to accomplish the mission. When given authority and the means to accomplish the CAS mission, decentralized control is effective and works well overcoming uncertainty on the battlefield.

A good way to think about C2 frameworks is offered in the book *Enhancing Dynamic Command and Control of Air Operations Against Time Critical Targets*. Here, the authors

[25] According to Joint Pub 1-02, a mission type order is "an order issued to a lower unit that includes the accomplishment of the total mission assigned to the higher headquarters." It is also defined as "an order to a unit to perform a mission without specifying how it is to be accomplished." In most cases, the later definition is more accurate.

define three different C2 frameworks: command-by-direction, command-by-plan, and command-by-influence.[26] Command-by-direction occurs when a commander tries to singularly control their forces at all times. This approach is similar to the C2 used in nuclear missions and parallels Napoleon's concept of micromanaging battle from the rear. Command-by-plan is analogous to the C2 needed for strategic air warfare and overcomes the problems associated with command-by-direction (e.g., large spans of control and massed forces with limited communications make centralized decision-making difficult). Lastly, command-by-influence (also known as MTO) grants subordinates great latitude to take action by delegating authority to them with commander's intent. This C2 approach encourages subordinates to take advantage of fleeting opportunities without having to wait for approval. This not only speeds tempo, but because it decreases the requirement for subordinates to communicate quickly with higher authorities, bandwidth requirements are also decreased.[27]

Different Conflicts

Not only must C2 frameworks conform to political constraints and different missions, but they must also change to support different types of conflicts. This includes different military phases occurring within a campaign.[28] The discussion starts by explaining how different conflicts affect decision-making authority, and then it investigates organizational structures.

Authority is defined as the "power to judge, act, or command."[29] This means that if controlling agencies were not given authority, they would not have "power to act." Thus, they could not control. Were this to happen, the agencies would become communication relays stringently following higher-level directives. This "do-what-your-told" centralized C2 structure

[26] Howard G. Coombs, Allan English, and Richard Gimblett, *Networked Operations and Transformation* (Montreal, Canada: McGill-Queen University Press, 2007), 19-20.
[27] A full discussion of bandwidth requirements and limitations occurs later in the chapter.
[28] According to JP 1-02, a phase is "a definitive stage of an operation or campaign during which a large portion of the forces and capabilities are involved in similar or mutually supporting activities for a common purpose."
[29] *Random House Dictionary*, 55.

requires subordinates to seek approval before acting. This inhibits initiative and motivation and, if taken to the extreme, can place subordinates in dangerous situations as they parry the enemy's blow while waiting for direction.[30] In addition, it abrogates the need for subordinates to take responsibility for their actions. Here, those directing the action must take responsibility for the outcomes. Conversely, commanders can empower subordinates by delegating decision-making authority to lower levels—granting them increased freedom of action while increasing tempo and decision-making speed—also known as the OODA Loop.[31]

The OODA (Observe, Orient, Decide, Act) Loop concept advocates paralyzing the enemy by seeking to disrupt the enemy's command and control decision-making process by inducting chaos and confusion into the system. By completing the OODA Loop faster than one's opponent, a temporal advantage is gained which leads to the enemy's psychological paralysis. It is important to note that the faster actions must occur at the execution level, and, therefore, it is important for a commander to grant decision-making authority to the lowest possible levels. Running a faster OODA Loop at operational and strategic level may have its use, but in the end, only to the extent in which it empowers subordinates for success. The idea of creating paralysis is not entirely original as Sun Tzu, B.H. Liddell Hart, J.F.C. Fuller, and others also embraced the concept.

To keep actions congruent with the war's aims, subordinates are told commander's intent along with rules of engagement (ROE) that specifies when and to what extent they should act.[32] When combined with a decentralized C2 system that provides sufficient oversight, subordinates

[30] The former Soviet C2 system followed this approach by centralizing decision-making at high levels in many aspects. The approach stunted initiative, lowered morale, and resulted in catastrophic consequences during World War II. Milan N. Vego, "Operational Command and Control in the Information Age," *Joint Forces Quarterly*, issue 35, 101.

[31] Col John R. Boyd, "A discourse on Winning and Losing," briefing, August 1987.

[32] Generally speaking, Airmen do not understand commander's intent because "centralized control (planning), decentralized execution" is largely "do what you're told" command.

have the freedom to act with commanders and control elements intervening only when necessary. The following examples illustrate how authority can change with different types of conflict.

In small conflicts where spans of control are minimal, or in phases with reduced operations, commanders may retain decision-making authority at high levels to lower the risk of subordinates making poor decisions and producing unwanted effects. This centralized C2 approach works in these situations because spans of control are small and the decisions are not as time-sensitive as in high-tempo combat operations. Hence, high-level commanders can withhold decision-making authority and make tactical-level decisions with little risk or detriment to mission success. In large conflicts, however, this approach falters.

Large conflicts that involve major operations and fast-paced combat usually require large amounts of forces. With large amounts of forces, however, commanders do not have the means or resources to micro-manage all tactical-level decisions. This limitation forces commanders to delegate authority to lower levels so subordinates can act quickly and decisively. If this were not done, subordinates would be hamstrung achieving success in battle. Another way to tailor C2 systems for differing conflicts is to alter their structures.

A structure is defined as "the manner in which the elements of anything are organized or interrelated."[33] For the purposes of this discussion, the elements are the various C2 nodes starting at the top with the JFACC and ending at the bottom with tactical units. Therefore, a C2 structure defines how these nodes are organized and interrelated. Because airpower supports (or is part of) a larger joint force, its structure must support and interface with the joint force's C2 structure, otherwise known as the Theater Air-Ground System (TAGS). To accomplish this, the Air Force built an airpower C2 network called the Theater Air Control System (TACS).

The TACS is an entire array of C2 nodes consisting of the AOC, Joint Surveillance and

[33] *Random House Dictionary*, 864.

Target Attack Radar System (JSTARS), Airborne Early Warning and Control System (AWACS), Control and Reporting Centers (CRC), Air Support Operations Center (ASOC), Terminal Air Control Party (TACP), Joint Terminal Air Controller (JTAC), and Forward Air Controller-Airborne (FAC-A). The system was designed in the Cold War to conduct major combat operations by integrating all of these C2 elements into a harmonious network that not only directs air assets to accomplish the JFACC's plan, but also redirects assets in real-time to overcome enemy adaptations. Though the system has worked well in the past, the TACS is now struggling to meet mission requirements.[34]

The problem largely exists because TACS was designed to execute major combat operations in the Cold War, and since then, little or no funding has been allocated to improve or modernize it. Therefore, the system now has difficulty adjusting to low-intensity fights with highly decentralized operations.[35] To its credit, the Air Force has made significant gains by implementing work-arounds into the system, but even with the changes, ground component and air liaison officer relations are strained below the division level.[36] The Air Component Coordination Element (ACCE), Battlefield Coordination Detachment (BCD), and liaison officers (LNOs) have also tried to make up the deficiency, but they too have not been successful due to lack of resources and far geographic proximities that make it hard for them to interact.[37] In addition, because modernizing TACS has not been a service priority, today the system is not well integrated, networked, resourced, or manned.[38] For example, Falconer AOCs are operating at 50 percent (or less) of their required funding, and manning is at about 70 percent.[39] On top of this,

[34] Robb Evans, "Marine Corps Air Force Warfighter Talks Findings," (Unpublished report, AF/A5XS, 2008), 1; Mike Adams, Theater Air Control System—21st Century Challenges, 1 May 08, slide 3.
[35] Mike Adams, "Theater Air Control System," slides 4-5.
[36] Robb Evans, "Marine Corps Air Force Warfighter Talks Findings," 6.
[37] Ibid., 8.
[38] Mike Adams, "Theater Air Control System, slide 5.
[39] "Integration of Airpower in Operational Level Planning Report," 23.

CRC equipment is mostly obsolete.[40] Though the Air Force is working to solve the problem, the solution must include more than simply updating or repairing the old system. Instead, the new system must support joint airpower across the full range of operations—not just major operations—and include evolving future capabilities and technologies. Because many C2 variations exist, a "scalable" and "tailorable" approach that uses "plug and play" C2 elements may be best.

This is not to say that innovative Air Force commanders have not "scaled" and "tailored" C2 systems in the past to meet mission requirements. They have; however, this paper is suggesting/recommending that C2 planning should be conducted beforehand with adaptable architectures that provide commanders with a full arrangement of capabilities. With many options available, commanders can implement the best C2 framework (or any variation thereof) right from the start, which is currently not the case. Air Force doctrine already endorses this approach in its Air and Space Expeditionary Task Force construct.[41] If designed properly, tailorable C2 structures will support all types of warfare—conflicts ranging from major operations to irregular warfare to humanitarian relief missions—big and small, today and tomorrow.

Human Relationships and Trust

This section investigates human interaction and command relationships necessary for trust and confidence to exist in C2 systems. It identifies areas needing improvement and then offers four solutions to bolster trust and cooperation.

Command Relationships and Trust

[40] The An/TYQ-23 MCE CRC has not been updated since the mid-1980s. The other CRC radar, the TPS-75, along with battle management computing systems, are also obsolete. Ibid., 30. In addition, Air Liaison Officers (ALOs) are not equipped to provide the CFACC's intent to their ground commanders.
[41] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 17 November 2003, 61.

"Getting command relationships right up front is absolutely critical to success."[42] The relationships help develop trust among commanders and allow them to comfortably delegate their authority to others. A good example is Gen Kenney and Gen MacArthur's relationship in World War II. Before Gen Kenney earned Gen MacArthur's trust, Gen MacArthur gave Gen Kenney specific detailed guidance. In essence, Gen MacArthur did not fully trust Gen Kenny, and because of this, he felt obliged to tell Gen Kenny not only what to do, but also how to do it. However, once Gen Kenny earned Gen MacArthur's trust, Gen MacArthur started giving broad mission-type orders.[43] This gave Gen Kenney more flexibility to innovate and better achieve Gen MacArthur's objectives. The extension of trust translated to passing the trust down to lower and lower levels, which resulted in even more innovation and initiative to help win success.[44] A similar relationship existed between Adm Nimitz and Adm Spruance. In the end, the entire C2 chain was underpinned in trust—trust that allowed commanders to delegate and decentralize their authority to subordinates. Surprisingly, the current command structure in Operation Iraqi Freedom (OIF) makes building trust through habitual relationships difficult. A recent Air Force report stated the current command structure "does not allow for close contact, trust, and relationship building between senior Airmen and senior ground component commanders."[45]

The disconnect largely exists for two reasons. First, the CFACC is heavily tasked, and second, it is difficult for the CFACC to build habitual relationships because the CAOC does not allow the CFACC to co-locate with other senior joint force commanders. The first problem, CFACC over-tasking, exists because only one CFACC is designated to meet all of CENTCOM's airpower needs. This equates to one CFACC trying to serve two different commanders running

[42] Gen Gary Luck and Mike Findlay, 40.
[43] *United States Strategic Bombing Survey (USSBS), Pacific War*, vol. 71 (War Department: Military Analysis Division, 1947), 24.
[44] Michael E. Fischer, "Mission-Type Orders in Joint Air Operations," (Thesis, Air University, 1995), 19.
[45] "Integration of Airpower in Operational Level Planning Report," 19.

two different campaigns—OIF and Operation Enduring Freedom (OEF). And even if the CFACC had the means (i.e., people and equipment) to adequately meet each commander's needs, they would still be forced to decide where to spend their time as they can only be in one location at a time. Making it even more strenuous, the CFACC is also dual-hatted as the 9th Air Force commander.[46] This additional responsibility requires the CFACC to further prioritize their time on service-related matters. The additional burden has forced the CFACC to deploy his 9th Air Force deputy commander to the Al-Udeid CAOC full-time to execute operations. While this action has given the CFACC needed flexibility to focus on other matters, it has also led to a perception that "the Air Force is not there, or that the Air Force is not all in."[47] Because of the seriousness of the matter, the Air Force is considering several options—from offering additional CFACCs for OIF and OEF to beefing-up low-echelon manning at the brigade and battalion levels. The second reason for the disconnect is the CAOC's inability to locate forward, thus making it more difficult for the CFACC to build habitual relationships.

Because AOCs cannot easily re-locate, CFACCs are forced to make a difficult decision.[48] The decision is to deploy forward with the JFC so they can build habitual relationships and trust, but remain absent from the AOC where they are needed to make decisions; or to remain with the AOC and use other venues like VTCs to build relationships.[49] But according to senior officers,

[46] In addition to serving as the air component to CENTCOM, 9th Air Force also oversees five active duty flying wings and 18 Air National Guard and Air Force Reserve units.
[47] "Integration of Airpower in Operational Level Planning Report," 17.
[48] In the current combined fight, the CAOC responsible for OIF and OEF is located in Al Udeid, Qatar. This is thousands of miles away from MNF-I's headquarters in Baghdad, Iraq and ISAF's headquarters in Kabul, Afghanistan. Airmen acknowledge that the distance makes joint integration difficult. "Integration of Airpower in Operational Level Planning Report," 2. Other CAOCs, such as the one located at Osan AB, Korea, are located in close proximity to other senior joint commanders.
[49] Lt Gen Heflebower suggested that even though doctrine has provisions to allow the CFACC to move forward away from the CAOC, it is not easily done because of the continuous interactions needed to keep CAOC planners and strategists on track. Lt Gen Charles R. Heflebower (class address, Air War College, Maxwell AFB, AL, 18 Nov 2008).

VTCs are a poor substitute for daily interaction.[50] To help overcome this deficiency, the Air Force created Air Component Coordination Elements, or ACCEs.

ACCEs help overcome the CFACC's dilemma by placing a senior Air Force officer forward that personally represents them to the JFC. This officer is complemented with a small staff and is a liaison to a lateral functional or service component commander, or a separate JTF/CC to which the JFACC is providing some type of support.[51] Brig Gen Hoog, who served as an ACCE to Multi-National Forces-Iraq (MNF-I), said "the ACCE is the oil and grease that make the joint warfighting process work."[52] While true, a recent report suggests there are problems with the concept—the ACCE does not have the authority or means to make decisions on behalf of the JFACC.

Because the ACCE does not have JFACC decision-making authority, "the ground staffs have come to view the ACCE as another layer to go through to get the help they need."[53] Because of this, the JFC does not have a "single-voice, one-stop shop" for airpower. This oftentimes requires them to use other venues to get their needs met. When this happens, the ACCE loses credibility and becomes impotent.[54] One possible solution is make ACCE's commanders and grant them decision-making authority with appropriate forces, C2, and larger staffs. But when previous ACCEs were asked if this was a good idea, most did not support it because they felt command duties would detract from their ability to perform as ACCEs. This concern was underscored when commanding start-up organizations requiring significant amounts of time.[55] Because of these reasons, making ACCEs into commanders is not a good idea. But,

[50] Lt Gen Short attests that had he been able to look General Wesley Clark in the eye and have frank dialogue, he could have done a much better job prosecuting the war. Lt Gen Michael C. Short, 6 November 2008.
[51] Air Component Coordination Element Whitepaper, unpublished report, and 5.
[52] Ibid., 10.
[53] Ibid., 27-28.
[54] Ibid., 12.
[55] Ibid., 18.

there are some other solutions that, when implemented together, might help.

One possible solution is for the Air Force to develop a deployable AOC, or as a minimum, deploy parts of it forward. This would allow the CFACC to locate with other commanders and build habitual relationships to develop trust. Because it would likely take time to set-up a deployable AOC, the permanent Falconer AOC (already responsible for the theater) could carry the load until it was up and running. Once running, manning from the Falconer AOC could move forward with augmentees filling-in behind. This concept allows the CFACC a forward presence; it abrogates the need for an ACCE; and it provides redundancy—if the forward CAOC is degraded or destroyed, the Falconer AOC in the rear is postured to pick-up the workload. In the end, a deployable AOC (or at least deploying parts of it) solves many problems, and the concept was proven to work in the Gulf War by Gen Horner, and again later in OIF by Gen Moseley.[56]

Another way to help build trust (at lower levels) is to deploy airmen serving in joint jobs or those interfacing with joint forces from four months to one year. Currently, the Air Force mostly deploys airmen in accordance with the Air Expeditionary Force (AEF) construct. This construct provides an overarching force deployment plan that incorporates Airmen from across the force and seeks to deploy them for four months out of every twenty. This construct was implemented to ease deployment burdens, and raise morale and retention by not only limiting deployments, but by also providing airmen predictability on when they were eligible to deploy.[57]

---

[56] Lt Gen Horner moved his TACC from 9th AF at Shaw AFB to Riyadh, Saudi Arabia. He greatly praised the ability to have direct interaction with the JFC, Gen Schwarzkopf. Jamieson, *Lucrative Targets*, 20. Another example that proves this point occurred when the 9th AF CFACC, Gen Moseley, went forward to Prince Sultan Air Base to conduct operations in OIF and delegated operations in OEF and Horn of Africa to a second CFACC (Maj Gen Elder) located at Al-Udeid, Qatar.

[57] For over 12 years Airmen serving in 9th and 12th Air Forces (located in the United States) primarily executed Operations Northern and Southern Watch in Iraq. Once the AEF construct was implemented, practically all AF Airmen became eligible to deploy. The additional Airmen spread the deployment burden across more people, thereby easing the burden for each airman. Maj Gen Hoog, telephone interview, 9 Jan 2009.

But, it does not align well with the other services' deployment schedules. Today the Army deploys troops for twelve months; the Marines for seven months. Though some Air Force officers (i.e., mostly colonels and general officers) deploy for one-year, the majority of Air Force personnel deploy for only four months. Hence, they rotate out two to three times faster than the others. This makes it difficult for joint warfighters to build habitual relationships and trust needed to optimize teamwork.

Another method that can help build trust is to require deploying Air Force personnel to train with other deploying joint forces before going into harms way. Many times Airmen participate in exercises and work-ups to help joint forces prepare for combat, but when it comes time to deploy, different Airmen are sent forward—not the ones that participated in the training. This is problematic as it requires the force to start over building relationships—but now during combat. This is faulty. Airmen participating in the exercises should be the same ones that deploy. This way trust is developed beforehand.

Last, one can bolster trust by reemphasizing a "warfighting" culture within the service. This can be achieved by developing an Air Force career track that grooms officers for future high-level air or joint C2 billets and commands. According to two Air Force generals, the Air Force does not currently emphasize the need for officers to have AOC, TACS, or ALO warfighting experience, nor does it adequately reward those that do.[58] This has discouraged many officers from pursuing it. In order to reverse this trend, the Air Force must determine what experience and training is needed for tomorrow's CFACCs, and then create a career track that provides it. One option is to give ALOs joint tour credit to allow them follow-on command opportunities. After this, the Air Force must determine how warfighting experience should influence promotion. If done properly, the new track would encourage officers to pursue AOC,

[58] Lt Gen Michael C. Short, 6 November 2008; Lt Gen Joseph E. Hurd, 13 November 2008.

TACS, and ALO duty. This approach has worked in the Marine Corps where officers must have Marine Air Command and Control System (MACCS) experience before they can successfully compete for command.[59]

To create a warfighting career track, Lt Gen Hurd (ret) suggested that the Air Force identify senior captains and junior majors and purposefully grow them into tomorrow's warfighting leaders. This, he suggested, would require multiple AOC tours, joint assignments, and joint schools—a focus away from traditional Title 10 duties that organize, train, and equip—in an attempt to reshape service culture towards warfighting. He stressed that only with a deliberate approach can tomorrow's CFACCs be fully trained and ready to meet future challenges.[60]

Flat Verses Hierarchal C2 Structures

This section investigates flat C2 organizational structures to determine if they are more effective than traditional hierarchal frameworks. This is important because some experts assert that flat organizations using Network Centric Warfare (NCW) are best suited for future warfighting. The idea is that "future organizations will be built to exploit modern information-handling equipment. This means flattening organizations, eliminating most middle management, pushing decision making to very low levels, and forming worldwide neural networks on the ability of units in and out of the direct conflict area."[61] While this approach might be appealing from an operational perspective, or in operations where a small number of forces are fighting other flat, networked forces (such as non-state terrorists), it undercuts many essential C2

[59] Evans, "Marine Corps Air Force Warfighter Talks Findings," 11.
[60] Lt Gen Joseph E. Hurd
[61] John A. Warden, "Air Power for the Twenty-First Century," in Karl P. Magyar, Editor in Chief, *Challenge and Response: Anticipating US Military Security Concerns* (Maxwell AFB, AL: Air University Press, August 1994), 329-330.

elements for three reasons.[62] First, it increases span of control so much that commanders will not likely have enough time to foster habitual relationships. Second, it requires commanders to make too many decisions, too fast, without enough information. And third, by forcing commanders to provide oversight to more subordinates, it makes preventing drift more difficult.

Because flat C2 structures increase a commander's span of control (i.e., they must supervise more subordinates), it is more difficult for them to build personal habitual relationships. In a time-constrained environment where many competing priorities exist, requiring commanders to divert more of their time to relationship building may come at the expense of war-making. With geographically separated units (GSUs), the problem is even more pronounced. In the end, flat C2 structures require commanders to spend more time with more subordinates—time that is already limited. For this alone, flat C2 structures are problematic from the start.

The second reason flat structures are inferior is they require commanders to singularly make too many decisions, too fast, without enough information. Known as the OODA Loop, commanders strive to make optimal decisions faster than the adversary.[63] Commanders make the decisions based on pertinent information derived from an overabundance of data. Though computers can help sort through the data, commanders do not always get the information they need or have ability to understand and respond to it in time.[64] Therefore, commanders do not always make optimal decisions, but strive to make fast decisions that are good enough.[65] This oftentimes leaves plenty of room for improvement. Flat C2 structures make the situation worse

[62] For a full discussion on how best to defeat networked organizations (such as al-Qaeda) using irregular warfare, see Thomas Hammes' book, *The Sling and the Stone*.
[63] For more discussion on OODA Loops, refer to "There Are No 'One Size Fits All' C2 Systems," subsection "Different Conflicts," in this paper.
[64] Gen Gary Luck and Mike Findlay, "Joint Operations Insights and Best Practices," 8.
[65] Robert S. Bolia, "Power to the Edge" Book Review, *Air & Space Power Journal*, Summer 2006, http://www.airpower.maxwell.af.mil/airchronicles/bookrev/hayes2.html.

by requiring commanders to make even more decisions. While computers could help if programmed to make decisions automatically, they are not accountable; commanders are. Also, war is humanistic; commanders have to apply operational art, which computers do not, and will not, have the capacity to do. For these facts, commanders will not likely allow computers to make decisions without adequate oversight.

Flat C2 structures also make preventing drift more difficult. This occurs because flat C2 structures reduce (or eliminate) mid-level C2 elements. This requires commanders to provide direct oversight to more subordinates, which is difficult to accomplish in large operations. Without adequate oversight, subordinates tend to drift (i.e., not follow established procedures).[66] The result is a loosely coupled C2 system where the mission is getting done, but not necessarily in accordance with established doctrine, standard operating procedures, or commander's guidance.[67] Though not always a problem, loosely coupled C2 systems can become dangerous when mission intensity suddenly increases.

When mission intensity quickly increases, loosely coupled C2 systems fail because they cannot function fast or effectively enough to meet new mission demands. This happened when two F-15s shot down a friendly Blackhawk helicopter during Operation Provide Comfort, and again later in Operation Anaconda where friendly forces fought in chaos at times shooting at each other due to severe confusion on the battlefield.[68] In both cases, the C2 systems were too

[66] Lt Col Michael Kometer, *Command in Air War*, 16, 272.
[67] Coupling is the amount of impact that the actions from part of an organization have on another. For example, in a university, one department's actions do not really directly affect another's actions. But in war, CAS operations directly impact ground operations. Lt Col Michael Kometer, personal memo, 7 Jan 2009.
[68] In 1994 two United States F-15s shot down a friendly UH-60 Blackhawk helicopter while on patrol in northern Iraq. It was found that significant drift occurred within the C2 system that led to the tragedy. In Operation Anaconda targeting authority was held at USCENTCOM, but USCENTCOM did not establish C2 nodes (like the ASOC) to ensure the Special Operations Terminal Air Controllers (SOTACs) were following established procedures. With little depth and oversight, the forces drifted. Later, when they encountered staunch opposition that required more effective C2, the system failed. The SOTACs and aircrew were left fending for themselves. Ibid., 275.

"loose" to avert catastrophe. To prevent disasters like these from occurring, tightly coupled C2 systems are needed where C2 processes and functions integrate quickly and seamlessly to meet mission demands. This requires a well thought-out system where control elements are properly equipped, trained, and clearly understand their roles and responsibilities. Adding depth to the C2 structure also helps.

Depth is not only the amount of layers, but also the amount of authority and direction given to lower subordinate control elements.[69] This leads to increased oversight and helps prevent drift. Without depth (i.e., no mid-level layers, just top and bottom), commanders would have to wholly manage subordinate actions themselves or allow them complete independence.[70] Depth is good because it provides commanders more options to delegate authority, and it increases C2 redundancy and robustness by creating more checks and balances to guard against random failures.[71]

There are many ways to increase depth. The first (and essential) way is to rethink, modernize, and upgrade elements of TACS so it can execute its roles and responsibilities. After this, a fully capable battle management aircraft (such as a modified AWACS or JSTARS) should be integrated into the TACS. This aircraft would provide the joint force with an airborne C2 platform capable of fusing all parts and pieces of the battle—air, ground, space, and cyberspace. This is not available with today's airborne platforms. This fully capable C2 node would allow the JFACC to decentralize decision-making by delegating authority to a capable, forward-based C2 element—thus increasing depth and robustness. Other ways to add depth include

[69] According to Lt Col Kometer, "depth is a measure of the extent to which diverse players at the scene of battle can be coordinated, prioritized, and redirected when the situation calls for it. It is not simply pushing information and authority down, but extending the spiral empowerment and accountability so that decisions made on the scene are consistent with the larger strategy." Ibid., 16.
[70] Ibid., 17.
[71] Ibid., 250.

implementing an Airspace Management Authority or the Joint Air-Ground C2 (JAGC2) cell.[72] Though these concepts are not currently established in joint doctrine, each integrates and harmonizes airpower by adding more depth where it is most needed—between the operational and tactical levels of war.

In the end, flat C2 structures may offer specific operational advantages, but they are generally problematic when it comes to C2. This is especially true in large campaigns where commanders have large spans of control. In these cases, hierarchal C2 structures are better because they help prevent drift and keep pace with the dynamics of combat.

Bandwidth Limitations and System Vulnerability

Bandwidth provides the means for electronic media to travel from one device to another, and it is important because C2 information travels by it (normally by radio, satellite or fiber cable) between users. Since bandwidth is quantifiable with limits, disregarding it could lead to a situation where more bandwidth is needed than is available. It is also important to determine how vulnerable a system is to enemy attack so measures can be taken to make it more survivable. This section sheds light on these areas by investigating future bandwidth requirements and capabilities. It then evaluates future threats to determine what impact they might have on future C2 networks. The section concludes by discussing mission-type orders to help overcome the problems.

Bandwidth Limitations

[72] The AMA is a mid-level control element that breaks-down stove-piped control agencies into a more lateral and horizontal structure. Doing so, it enables real-time airspace management at lower levels. Victoria T. Habas, "Effective Airspace Management to Facilitate Fires—Establishing an Airspace Management Authority (AMA)," *Air Land Sea Bulletin* no. 2008-3 (September 2008), 18-19. The JAGC2 is a "flexible and scalable cell designed to fully integrate and coordinate fires and airspace over and within the ground commander's area of operations. The JAGC2 combines decision making authorities from the land and air components into a single empowered cell with the highest levels of situational awareness to support the maneuver commander's concept of operations. This cell functions as a C2 authority to more effectively execute the mission and reduce risk at the lowest tactical levels." Curtis Neil, "Joint Air Ground Control Cell," PowerPoint Briefing, ACC/A3F, 8 September 2008, slide 9.

Bandwidth is a measure of how fast information moves (normally in bits per second) from one electronic device to another.[73] It is the key enabler that transfers information from sensor to decision maker. In today's digitized operational environment (i.e., battlefield) that incorporates vast amounts of computers, communications equipment, and software, having enough bandwidth has become an enormous problem. From September 2001 to March 2003, bandwidth requirements grew from 46 Mega-bytes per second (MBPS) to 2.3 Giga-bytes per second (GBPS)—a fifty-fold increase. Since then, the requirement has increased another 250 percent to about 5.6 GBPS. Of the 5.6 GBPS, military satellites (MILSATCOM) provide only 2 percent, commercial satellites (COMSATCOM) provide about 33 percent, and fiber optic cables provide the rest (almost two-thirds).[74] But even with 5.6 GBPS of available bandwidth, the Army's current bandwidth demand exceeds it by a factor of ten.[75] In fiscal year (FY) 2015, experts predict that 35 GBPS of bandwidth will be needed, an increase of about 600 percent.[76] The requirement is driven mostly by more unmanned aerial systems (UAS) expected to be operating on tomorrow's battlefield, and the Army's desire to share UAS data with multiple users.[77] This bandwidth appetite is creating problems that even the best communications experts are struggling to solve.

Solving the problem revolves around two central issues--increasing the amount of available bandwidth while decreasing the requirement for it. To increase bandwidth, fiber optic

[73] Congress of the United States, *The Army's Bandwidth Bottleneck* (Washington DC: Congressional Budget Office, August 2003), ix.
[74] Ibid. US allies, the United Kingdom and Australia, provide small amounts of MILSATCOM support not included in these numbers.
[75] Ibid., x.
[76] Brig Gen Mark Bowman, USCENTCOM's View on C4 solutions for an Expeditionary Force, to Tactical C4 Conference, PowerPoint Briefing, April 22, 2008, slide 4.
[77] Congress of the United States, *The Army's Bandwidth Bottleneck*, 21; if the Army was to only transfer the video between sensor and shooter, bandwidth requirement would be reduced by one-third. Ibid., 29-30.

cable is the least expensive method.[78] It is also the most capable in terms of throughput. But, fiber optic cable is not always available in far reaching, underdeveloped regions of the world, and it is vulnerable to getting cut. In addition, fiber optic cable does not usually meet the needs of mobile forces that require bandwidth while they move. This limitation is huge considering practically all fielded forces have some degree of mobility. Here, mobile bandwidth systems like radios and SATCOM are needed.

Having enough SATCOM, however, is a problem because it currently provides only one-third of today's total bandwidth. This limitation largely exists because MILSATCOM is old and under-capable, and COMSATCOM is expensive to buy on the open market.[79] For example, the price for an additional 5 GBPS of COMSATCOM bandwidth is $453.6 million.[80] To absolve this dependency, six wideband global communication satellites (WGS) and four advanced extremely high frequency (AEHF) communications satellites are scheduled for launch by 2015.[81] Once all ten satellites are operational, they will provide about 14.2 GBPS of extra MILSATCOM bandwidth.[82] While this will provide a significant increase in the 2015 timeframe, the joint force is also pursing the Joint Tactical Radio System (JTRS) to meet short-term needs.

The JTRS is a joint effort to provide high-capacity bandwidth by developing and fielding wide-band network waveform (WNW) radios. Expected to be fielded by 2010, the radios will provide about one-order of magnitude more bandwidth than what is currently available using the lower tactical Internet.[83] According to Army FY10 projections, the JTRS will exceed squad and

[78] Fiber optic cable is about one-sixth the cost of SATCOM. Brig Gen Mark Bowman, slide 6.
[79] Brig Gen Susan S. Lawrence, "Using Net-Centric C4 to Win the Long War," USCENTCOM Report, 2007, 4.
[80] Brig Gen Mark Bowman, slide 6.
[81] Col Terry Djuric, "DIRSPACEFOR" (lecture, Air War College, Maxwell AFB, AL, 22 Oct 08). One WGS satellite has already been launched and is serving the pacific region.
[82] Each AEHF satellite is capable of 400 MBPS (1.6 GBPS total), and each WGS satellite is capable of 2.1 GBPS (12.6 GBPS total). The combined AEHF and WGS throughput equates to 14.2 GBPS. Col Charles Cynamon, personal interview, 13 Jan 2009.
[83] Congress of the United States, *The Army's Bandwidth Bottleneck*, 19-20.

platoon-level bandwidth requirements, but it will still fail to meet the company, brigade, and higher-level headquarters' needs.[84] The other services are also investing in the program, the Air Force itself over $950 million.[85] Sources do not confirm the extent the radio will meet the Air Force's bandwidth gap. What is clear, however, is that even with the increased bandwidth provided by MILSATCOM and JTRS, the bandwidth problem will only subside if the services also curb their appetites.

One way to reduce the appetite is to decrease the bandwidth footprint. Today there are over one-thousand different C2 applications used across the joint force, each serving to exacerbate bandwidth challenges.[86] Most of these applications are service-driven and do not function across the joint force. This results in a fragmented, inefficient, and congested system that not only increases bandwidth requirements, but also makes the system more vulnerable.[87] According to Brig Gen Susan Lawrence, CENTCOM's J6, solving the problem will require a long-term holistic approach with all services working together to develop a common joint architecture.[88] She goes on to say that it will also take the "Big Enterprise" of the Department of Defense (DOD), Department of State (DOS), trusted coalition partners, law enforcement agencies, and others to solve the problem.[89]

Another way to reduce bandwidth requirements is to minimize video, graphics, battlefield operating systems, and distributed databases.[90] Most services have instituted measures to eliminate unnecessary graphics and color from briefings and e-mail messages. But, video teleconferencing (VTC) is becoming more popular, and it uses a lot of bandwidth--about 1,000

[84] Ibid., 28
[85] Ibid., 33.
[86] Brig Gen Susan S. Lawrence, "Using Net-Centric C4 to Win the Long War," 22.
[87] Ibid., 4.
[88] Ibid., 6.
[89] Ibid.
[90] Ibid., 4.

kilo-bytes per second (KBPS). If the Army were to eliminate VTCs altogether, bandwidth requirements would decrease by 70 percent at the brigade level, and 15 percent at the corps level.[91] If this is not doable, VTC bandwidth requirements could still be reduced by a factor of ten if only voice with a whiteboard display were used.[92] While there are no numbers for the other services, similar results are likely. Because these savings are significant, reducing VTCs is a worthy goal. A synergistic effect could be achieved by locating commanders together so they can build trust and also reduce bandwidth requirements at the same time.

In the end, joint forces must strike a balance between bandwidth available and bandwidth required. Whether or not and to what extent this actually occurs is up for debate. Regardless of what happens, though, available bandwidth matters little if the enemy can render the C2 system useless. For this reason, it is important to determine how vulnerable the system is to enemy attack and implement measures to make it more survivable.

Vulnerabilities

Lt Gen Minihan, once the senior uniformed intelligence officer in the DOD, said, "we will use information to expand the adversary's and compress our own action loops. If you can't think, can't hear, and can't see—and I can—you will lose every time."[93] Certainly the enemy understands this idea too as it was embraced long ago by many theorists to include Sun Tzu, Clausewitz, and others. What has changed today is that C2's dependency on cyberspace makes decision makers vulnerable to decapitation in one fell swoop.[94] Secretary of State Condoleezza Rice acknowledged this by saying, "it is the paradox of our times that the very technology that

[91] Congress of the United States, *The Army's Bandwidth Bottleneck*, 28-29.
[92] Ibid.
[93] "Information Dominance Edges Toward New Conflict Frontier," *Signal International Journal* 48, no. 12, August 1994, 37.
[94] Cyberspace is defined as "a Global domain within the information environment consisting of the interdependent network of information technology infrastructures, including the Internet, telecommunications networks, computer systems, and embedded processes and controllers." DEPSECDEF Memo, 12 May 08; Ted Hailes, "Ptuiii…Cyber. Why do I Care?" (lecture, Air War College, Maxwell AFB, AL, 20 August 2008).

makes our economy so dynamic and our military forces so dominating also make us more vulnerable.[95] This vulnerability was recently highlighted on November 20, 2008 when a cyber attack infected over 1,500 Department of Defense computers, taking them off-line.[96] In the recent war between Russia and Georgia, Internet traffic was blocked with coordinated network attacks.[97] Similarly in 2007, cyber attacks on Estonia shut down government computers.[98] Some 17 years ago, General Merrill McPeak, then the Air Force's Chief of Staff, said after the Gulf War, "we don't really know whether the command structure was tough enough, durable enough, to survive really difficult combat conditions."[99] Since the command structure has yet to face truly difficult combat conditions, McPeak's question has not yet been answered. However, evidence suggests that protecting cyberspace in the future will be extremely difficult.

According to a recent report, ten-million bot computers were used to distribute span and malware across the Internet from April to June 2008.[100] To make matters worse, experts are predicting that malware will increase ten-fold in 2008 alone.[101] Most of the botnets originate in China.[102] In addition, the top five emerging cyber threats will not only include Botnets, but also other forms of malware, cyber warfare, threats to voice-over-internet protocol (VoIP), and cyber crime.[103] When considering that many potential enemies continue to bolster their battlefield electronic warfare capabilities including Global Positioning System (GPS) jamming, communications and datalink jamming, and other electromagnetic and physical attacks, the cyber

[95] Ibid., slide 31.
[96]"Pentagon Cyber Attack—What you need to know," *Huffington Post*, 21 November 2008, http://www.huffingtonpost.com/2008/11/21/pentagon-cyber.attack_n_ 145581.html.
[97] *Emerging Cyber Threats Report for 2009* (Atlanta, GA: Georgia Tech Information Center, October 2008), 3-4.
[98] Julian E. Barnes, "Cyber attack on Defense Department Computers Raises Concerns," Julian E. Barnes. *Los Angeles Times*, Nov 28, 2008, http://www.latimes.com/news/nationworld /nation/la-na-cyberattack28-2008nov28,0,06441140.story
[99] "USAF Chief Plans War's Command Chain," *Defense Week*, 2 December 1991, 1.
[100] *Emerging Cyber Threats Report for 2009*, 2.
[101] Ibid., 1.
[102] Bot computers are used by malicious operators to infect other computers (without them knowing) with harmful software. Ibid., 2.
[103] Ibid., 4-7.

threat cannot be overstated. Because these threats exist, some experts contend there are not enough resources (i.e., money, time or equipment) to protect against all of them.[104] Others believe networks are inherently resilient to failure because they are composed of vast arrays of nodes and processes.[105]

Network theory suggests that networks overcome random attacks fairly easily by rerouting information around degraded or destroyed areas. Good examples are telephone networks that optimize traffic flow based on network delays and congestion to maximize the system's effectiveness and efficiency. But when attacks are not random and focused on key hubs, the network can fail much faster.[106] If applied to today's centralized C2 structure with attacks on the AOC, associated communication lines, and other C2 hubs (e.g., the ASOC, AWACS, datalinks, etc.), system failure is possible. One way to prevent failure is to process information throughout the network instead of only the hubs.[107] This, however, is difficult to accomplish in today's fiscally constrained environment. Knowing all of this, if C2 networks are attacked, it is possible the network could collapse--if only for a short time. If this possibility exists, then consideration must be given to formulating an employment philosophy that allows forces to continue fighting if it were to occur.[108]

Mission-type Orders

Mission-type orders (MTO, also known as command-by-influence) is a well-established C2 philosophy that reduces day-to-day reliance on C2 networks by delegating decision-making

[104] CDR Richard M. Gomez, "Centralized Command—Decentralized Execution: Implications of Operating in a Network Centric Warfare Environment" (research paper, Air University, n.d.), 18.
[105] Lt Col Michael Kometer, *Command in Air War*, 250.
[106] Ibid.
[107] Ibid., 264. More network processing does not significantly increase network throughput because of increased complexity. For example, increasing the number of nodes by a factor of twenty only results in a three-fold increase in throughput. *The Army's Bandwidth Bottleneck*, 26.
[108] Phillip K. Heacock, "The Viability of Centralized Command and Control (C2)," *Air University Review*, January-February 1979, http://www.airpower.maxwell.af.mil/airchronicles/ aureview/1979/jan-feb/heacock.html.

with commander's intent to low-level units. Developed by the Prussian Army in the late 1800s, and later adopted in Airland Battle doctrine in 1982, the concept has gained considerable traction over time.[109] Joint Pub 1-02 defines MTO as "an order issued to a lower unit that includes the accomplishment of the total mission assigned to higher headquarters; an order issued to a unit to perform a mission without specifying how it is to be accomplished." Perhaps a better definition is "an order that communicates the superior commander's general intention to subordinate commanders or control elements to achieve desired operational effects." Essential elements are who, what, when, and why, but not how.[110] By not specifying "how" they are to accomplish the mission, subordinates are granted freedom to accomplish the mission based on the situation, their training, established procedures, ROE, and doctrine. Because the approach has worked well in the past, the concept is highly endorsed by the Army, Marine Corps, and Joint Forces Command (JFCOM).[111] In addition, Gen Luck asserted MTO as a way to "guard against the tendency and lure of technology to entice us to wrongly attempt to scientifically model outcomes and centrally control operations."[112] The long-standing problem with MTO, however, is not whether or not the concept is valid, but in trying to wholly apply the concept to airpower where there are no "one size fits all" C2 solutions.

There is merit, however, in trying to more fully integrate MTO into airpower operations when and where possible. The reasons for this are numerous. Subordinates are less dependent on day-to-day C2 connectivity because they are already empowered to act. It grants subordinates authority to deviate from the planned course of action when needed—thus giving needed flexibility to handle uncertainty. It embraces the warrior ethos by encouraging innovation and

[109] Col Robert W. Peterman, "Mission-Type Orders, An Employment Concept for the Future" (research paper, Maxwell AFB, AL, 1990), 4.
[110] Michael E. Fischer, "Mission-Type Orders in Joint Air Operations," 2.
[111] Gen Gary Luck and Mike Findlay, "Joint Operations Insights and Best Practices," 3.
[112] Ibid.

rewarding those that use their ingenuity to overcome problems. It makes individuals not only responsible for their actions, but also accountable for the outcomes. It also allows commanders to "command by negation." Here, commanders watch subordinates (and the outcomes) from a distance and intervene only when necessary. With this philosophy intact, failure of the C2 system still allows subordinates to function unimpeded, but without immediate command oversight. According to Martin Van Creveld, this philosophy has proven itself superior across 25 centuries of experience.[113]

As explained earlier, MTO forms the basis for CAS, and Gen Kenney used it in WWII to employ his Air Task Forces in the pacific. Later in the Gulf War, Lt Gen Horner used the concept to empower the 7440th Composite Wing (Provisional) located at Incirlik AB, Turkey.[114] Because MTOs offer many advantages over centralized C2 decision-making, Major Michael Fisher researched the topic in his thesis, *Mission-Type Orders in Joint Air Operations*, to determine how MTOs might be further incorporated into joint airpower today. He concluded that integrating MTOs into air operations require 1) trust at all levels of command, 2) unambiguous commander's intent (that is fully understood by subordinates), 3) a willingness to accept risk and uncertainty, 4) distributed intelligence, 5) effective communications among low-level units, 6) a robust body of common doctrine, 7) composite units, and 8) decentralization of targeting expertise.[115] He went on to conclude that while some of these elements already exist, some do not.

Major Fisher highlights several areas needing work, three specifically mentioned are doctrine, organization (i.e., composite units), and communications. Fisher first asserted that MTO must get fully codified into doctrine. Once codified and operationalized, Fisher believes

[113] Martin Van Creveld, *Command in War*, 274.
[114] Major Michael E. Fischer, "Mission-Type Orders in Joint Air Operations," 5.
[115] Ibid., 52.

mission-orders could speed air-to-ground employment while cutting the length of the ATO.[116] As for organization, composite units are needed. Here, the Air Force needs to fully operationalize Air Expeditionary Task Forces (AETFs).[117] AETFs are "scalable" and "tailorable" fully supportable composite units commanded by a single commander with appropriate C2 mechanisms.[118] Currently, the C2 mechanism largely equates to the TACS, which needs much rethinking, retooling, and modernization. If operationalized and updated, AETFs and TACS would largely provide the composite units and associated C2 needed to make MTO work. It would also require robust communications and dialogue between operational and tactical-level air and ground forces to ensure adequate support. Lastly, Major Fisher suggested that communications are needed among low-level units. He asserted that advanced technology will help make this a reality. Units will become more effective executing MTOs because they will have increased situational awareness to make better decisions.[119] In the end, he concludes that it is possible to incorporate the "MTO philosophy" more fully into air operations. It will require implementing Major Fisher's recommendations, fixing TACS, and senior Air Force leaders will have to embrace the shift away from centralization towards decentralization—a cultural shift that may be difficult, if not insurmountable.

Summary

This chapter provided insights and solutions into today's C2 problems. First, it found that no "one size fits all" C2 systems exist. Because of this, more flexible and adaptable "plug and play" C2 nodes are needed that allow JFACCs to create the right C2 system for the task.

---

[116] Ibid., 57-8.
[117] Ibid., 59. According to Air Force Doctrine Document (AFDD) 2, *Operations and Organization*, Air Expeditionary Task Forces can vary in size from an Air Expeditionary Squadron, commanded by a Major, to an Numbered Expeditionary Air Force (NEAF), commanded by a general officer. Regardless of the size, each AETF is tailored to contain all needed elements to conduct operations. Ibid., 46.
[118] Air Force Doctrine Document (AFDD) 1, 61.
[119] Major Michael E. Fischer, "Mission-Type Orders in Joint Air Operations," 62.

This approach provides the flexibility to work across the full range of military operations—conflicts ranging from major operations to irregular warfare to humanitarian effort--both big and small. And, it allows the best C2 system to be formulated early in the planning stages so the system can be implemented from the start. This largely eliminates today's "after the fact work-arounds" that attempt to force a system to do something it was never intended to do.

Second, habitual relationships that build trust are extremely important. This requires the Air Force to align airpower's C2 elements with those used by the joint force. There are several ways to do this, and they are not mutually exclusive of each other. They include a deployable AOC capability, extending deployments from 120 or 179 days to one-year, training together on mission rehearsals before deploying into combat, and placing renewed emphasis on building a career track to embolden the Air Force's warfighting culture.

Third, flat C2 structures are problematic because they make it harder for commanders to build habitual relationships, make optimal decisions, and provide adequate oversight to subordinates to prevent drift. A better approach is to build depth (or layers) into the C2 structure and then empower subordinates with MTOs at each layer based on mission requirements.

Last, analysis of bandwidth limitations and system vulnerability found that joint forces must strike a balance between bandwidth available and bandwidth required. This is best accomplished by increasing available bandwidth while decreasing bandwidth requirements. Additional MILSATCOM will help increase bandwidth, and decreasing the bandwidth footprint will decrease demand. The study also found that future enemies may attack C2 networks, and if they do, they might succeed in degrading or destroying the system. To decrease an attack's impact on air operations, analysis found that using MTOs as an overarching C2 philosophy could help make the meaningful employment of airpower within a joint campaign more survivable.

But, it is also practically impossible to apply MTO as the sole C2 construct because “no one size fits all” C2 frameworks exist. In the end, though, incorporating the “MTO philosophy” when and where possible is worthwhile because if has proven itself superior time and again. To accomplish this, the Air Force will need to invest in many areas that include doctrine development, fully operationalizing the AETF construct, fixing the TACS, and ensuring that effective communications exist among low-level units.

Chapter 3

Formulating a New Paradigm

"The most serious trend in the Armed Forces is the trend toward over centralized decision-making at the operational and strategic levels."
— Milan N. Vego, *Joint Forces Quarterly*

This chapter formulates a new paradigm for airpower C2. It begins by redefining the current paradigm, "centralized control, decentralized execution," by showing that it is not only confusing, but it also does not accurately represent de facto air operations. After this, a new C2 paradigm is offered—"centralized command, adaptive control, decentralized execution"—that better represents the evolution and totality of airpower employment. It also incorporates many of Chapter 2's findings. The chapter closes by offering broad suggestions on how the new paradigm might be implemented.

"Centralized Control, Decentralized Execution"

According to Joint Pub 1-02, "centralized control" is defined (in the context of joint air operations) as "placing within one commander the responsibility and authority for planning, directing, and coordinating a military operation or group/category of operations." This best equates to the JFACC formulating one air plan to support the JFC's overall campaign plan. The air plan is communicated daily to subordinates via the Air Tasking Order (ATO).[120] In essence, the ATO is the tool that allows the JFACC to practice centralized control. Lt Gen Horner (the CFACC in the Gulf War) said it best, "the ATO is the [C]FACC."[121] This is not to say that the

[120] The ATO is a published document that tasks air assets when, where, and (sometimes) how, to conduct operations. Based on the number of taskings, the document can range from 50 to over 700 pages in length. The ATO does not normally include rotary wing assets flying below a set altitude, such as Army and Marine helicopters conducting autonomous operations.
[121] Perry D. Jamieson, *Lucrative Targets. The U.S. Air Force in the Kuwaiti Theater of Operations* (Washington D.C.: Air Force History and Museums Program, 2001), 22.

JFACC cannot re-task or re-direct air assets if the need arises, but due to span of control and time constraints, the JFACC is simply incapable of singularly controlling (or directing) the vast number of airborne air assets at any given time. Because of this fact, and because of Moltke's accurate (yet overused) dictum that no plan survives first contact with the enemy, lower-level control elements must inform and direct forces so they can overcome enemy actions.[122] This lower-level control is captured in the "decentralized execution" part of the paradigm.

According to Joint Pub 1-02, "decentralized execution" is the "delegation of execution authority to subordinate commanders."[123] Though not mentioned in the definition, a subordinate commander's "execution authority" includes some degree of control. For if they could not control, they could not direct assets to overcome enemy actions—their sole purpose for existing. The Air Force's definition of "decentralized execution" also does not clearly communicate this requirement. And even if it did, it would create even more confusion because it would then directly convey that airpower is "centrally controlled" and "decentrally controlled" at the same time.[124] For many, this incongruity produces a question mark that is difficult to overcome. Because of this, the "centralized control, decentralized execution" paradigm does not add sufficient clarity and enhance understanding.

Another problem with the paradigm is that both the joint and Air Force definitions stipulate that control authority can only be delegated to lower-level commanders—not lower-level C2 elements like AWACS, ABCCC, or JTACs. This is problematic because joint air assets are routinely controlled by these (and other) control elements that bridge the gap between the operational and tactical levels of war. Because of this, and because of the reality mentioned

[122] Field Marshal von Moltke, *The Franco-German War of 1870-71* (English version, 1891), 10-11.
[123] Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms*. 12 April 2001.
[124] According to Air Force doctrine, "decentralized execution of air and space power is the delegation of execution authority to responsible and capable lower level commanders to achieve effective span of control and foster disciplined initiative, situational responsiveness, and tactical flexibility." Air Force Doctrine Document (AFC) 1, 97.

earlier where "centralized control" mainly equates to "centralized planning," the joint community has never fully embraced the "centralized control, decentralized execution" paradigm.[125] Why the Air Force has clung onto this paradigm for so long is puzzling, especially since it does not accurately represent de facto air operations either. Two operational and tactical-level airpower examples help illustrate this point.

First, the Air Force has invested a significant amount of money and resources to develop the Theater Air Control System (TACS). First used in Vietnam as the Tactical Air Control System, the current TACS has since evolved into a network of sensor and control elements to make airpower more responsive to the dynamics of combat. The system is composed of the AOC, CRCs, JSTARS, AWACS, ASOC, FAC-As, and JTACs.[126] Each element is delegated authority to control and/or redirect missions as needed. In the Gulf War, the ABCCC, AWACS, and the TACC (i.e., the AOC equivalent), could each issue target changes independently to B-52 crews (as could any TAGS or TACS C2 node).[127] Other examples such as Close Air Support and Scud Hunt missions also used decentralized control where aircrews worked in real-time with all elements of the TACS to find and engage enemy land and missile forces.[128] This is a case-in-point example where lower-level control elements—not subordinate commanders--controlled assets below the JFACC level. This flies in the face of the current "centralized control, decentralized execution" definition that asserts only commanders can be delegated control authority.

Second, during the Gulf War, the 7440th Composite Wing (Provisional) located at Incirlik, Turkey became the combat arm of Joint Task Force Proven Force and was given broad

---

[126] Col Mike Adams, "Theater Air Control System. 21st Century Challenges," briefed 01 May 2008 by AF/A3O-AY.
[127] Jamieson, *Lucrative Targets*, 89.
[128] Lt Col Michael W. Kometer, *Command in Air War* (Maxwell AFB, AL: Air University Press, 2007), 145, 243.

mission-type orders by Lt Gen Horner to operate in northern Iraq, specifically North of N3430 latitude.[129] Though their missions were listed on the ATO, as Lt Gen Horner's guidance mandated that all air sorties be listed in the document, they were not formally part of the JFACC's centralized planning process.[130] Instead, the wing planned their own missions and then provided their plan/targets to the JFACC's planners for inclusion into the ATO.[131] While not known to many, mission-type orders has been used throughout Air Force history, specifically when used in CAS and by Gen Kenney during WWII in support of Gen MacArthur.[132] The "centralized control, decentralized execution" paradigm does not fully represent this C2 philosophy because control was not centralized. Instead, control was decentralized (or delegated) to subordinates right from the start.

What does all this mean? First, the long-standing "centralized control, decentralized execution" paradigm is confusing and does not adequately codify airpower employment. Second, the paradigm's inaccuracy results in confusion within the joint community, which leads to negative overtones and a misunderstanding of airpower employment. Last, and as seen in Chapter 2, the paradigm fails to capture the evolving nature of battle, the continuation of technology, and the needed flexibility to take future C2 systems to higher levels. To rectify the situation, a new paradigm is needed—"Centralized Command, Adaptive Control, Decentralized Execution."

A New and Better Paradigm

To explain the new "centralized command, adaptive control, decentralized execution" paradigm, discussion starts at the top and moves down. Thus, it begins by defining and

[129] Major Michael E. Fischer, *Mission-Type Orders in Joint Operations* (Maxwell AFB, AL: Air University Press, 1995), 36.
[130] Francis H. Ayers, "Mission-Type Orders and Joint Air Employment Doctrine" (Thesis, Carlisle Barracks, 1996), 6.
[131] Fischer, *Mission-Type Orders in Joint Operations*, 39.
[132] Ayers, "Mission-Type Orders and Joint Air Employment Doctrine" (Thesis, Carlisle Barracks, 1996), 6.

explaining centralized command, and then moves to adaptive control. Decentralized execution is discussed last. The section comes to a close by offering suggestions on how the paradigm might be implemented in the future.

Centralized Command

Since failure in Operation Torch (i.e., Kasserine Pass) where airpower's effectiveness was restricted by the parceling out of air assets, airpower advocates have embraced the need for a single functional air commander; a commander that understands airpower's inherent flexibility to roam and engage enemy forces both linearly and in depth (or parallel) across the battlespace. The concept finally came to fruition with the creation of the first J/CFACC during the Gulf War.

According to joint doctrine, the JFACC is appointed and given authority to recommend how to best employ assigned, attached, and/or other air forces. This includes planning, coordinating and executing air operations as needed.[133] Only one commander (i.e., the JFACC) is given this responsibility to achieve unity of command and, more importantly, unity of effort. This allows the JFACC to task all air forces—assigned, attached, joint, or coalition. If several commanders had this responsibility, each would likely try to employ airpower in their own way, and thus not achieve all available synergies. This is important because airpower's speed, reach, and flexibility enables it to overcome obstacles and react much faster than traditional ground forces. With one designated commander, all air assets are harmonized and integrated to achieve synergistic effects across the battlespace. With the ability to centrally command air forces (via the AOC and ATO), the JFACC is best suited for this task. With this, "Centralized Command" is offered as the first part of the new paradigm.

Adaptive Control

Merging several existing definitions together, "Adaptive Control" is defined as a

[133] Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms.*

"tailored, responsive, and integrated control system that plans, directs, prioritizes, allocates, synchronizes, and harmonizes air and space capabilities by using the full gamut of centralized and decentralized control methods. Delegating authority to lower level commanders and control elements using mission-type orders is prioritized to achieve both span and depth of control to foster initiative, situational responsiveness, and tactical flexibility."

Though somewhat long, this definition is well-suited because it reaffirms that there are no "one size fits all" C2 systems when it comes to employing airpower. It correctly identifies that both centralized and decentralized C2 are required depending on the situation, and it does not confuse the issue as did the previous paradigm. It stresses the importance of delegating authority to subordinate commanders and control elements using mission orders to increase tempo and keep operations intact if C2 is lost. Depth of control is added to reaffirm the importance of oversight to limit drift while inducing tight coupling. Lastly, since "adaptive" means "to adjust or become adjusted to new conditions," it explicitly captures the JFACC's requirement to dynamically change authority levels and structures with changing conditions. In the end, "Adaptive Control" is a more accurate paradigm that fully represents the various types of controls needed to execute airpower across the entire range of military operations.

Decentralized Execution

Decentralized execution is redefined as "the ability for lower level forces to act freely in accordance with higher level guidance and commander's intent." This definition serves to limit individual actions only to the extent dictated by higher authorities. In cases where centralized control is needed with stringent ROE, the definition restricts subordinate actions accordingly. Conversely, when decentralized control is needed using mission-orders, it gives subordinates the freedom to act, innovate, and overcome the enemy to accomplish their commander's intent. This

definition, though simple, adequately covers the full range of C2 options, and it grants responsibility and accountability to subordinates needed to make the system work. To enable decentralized execution to work, it will be essential to modernize TACS along with changing Air Force culture so subordinates understand commander's intent at the tactical level.

How to Proceed

A full analysis on implementing the new paradigm is well outside the scope of this paper, but there some things worth mentioning. First, because there are no "one size fits all" C2 systems, the Air Force will need to decide what overarching C2 system is best suited (as a point of departure) for training its forces. When viewed from the tactical "grassroots" level, it may be better to train forces with MTOs as the overarching C2 philosophy, than to train for the centralized "do what you're told" approach. Said another way, tactical-level units are more likely to succeed if they train for the harder (i.e., decentralized MTO operations that require initiative, innovation, and free-thinking) and are later restrained in combat, than to train for the easier (i.e., centralized operations that require them to "do what they're told") and later hope they can develop higher skill sets not yet exercised in training.

To accomplish this, the Air Force must first teach MTO as a command philosophy, and it must learn and instruct forces how to execute their new roles and responsibilities. This will not be easy as the current "centralized control, decentralized execution" paradigm largely equates to following an ATO. To overcome this, a new training framework is needed. Since the Army and Marine Corps have made significant progress embracing MTO into their cultures, the Air Force should begin by learning and adopting lessons from them. Not all lessons will apply due to differences in operating mediums and employment concepts, and no attempt should be made to force them.

Today, the Army and Marines spend significant time writing mission statements and commander's intent, and they also practice deciphering lots of information so they can make the right decisions in order to achieve commander's intent. Perhaps this would be a good place to start. It will not be easy. In the end, using MTOs as a "point of departure" may not be feasible, and there should be no retribution if, in fact, this is true. The Air Force is responsible for executing many missions, and as stated before, there are no "one size fits all" C2 systems. MTO, however, has potential to work in many mission areas while reducing bandwidth vulnerabilities. These reasons highlight why MTO is worth fleshing-out; the approach promises too much gain for it to be quickly dismissed.

In addition, the Air Force needs to devise and implement an overall air warfare training strategy to ensure basic-to-advanced levels of air warfighting knowledge exist across the Air Force, especially within the rated career field. Today there is a wide disparity of air warfighting knowledge that exists between aircraft pilots. For example, one Lt Col F-16 pilot may understand CAOC, TACS, and TAGS processes, and another may not. While there is an attempt to educate and practice air warfighting skills within formal Air Force schools (i.e., Airmen's Basic Course, Squadron Officers School, Air Command and Staff College, and Air War College), there is not enough emphasis or an adequate overarching training strategy to ensure all have a common basic-to-advanced understanding of air warfighting—regardless of whether or not they attend a service school, as many do not. If done correctly, implementing an adequate overarching air warfare training strategy will help stop the "piece-meal" effect where the same officers are selected time-and-again for warfighting duties leaving other capable, but uninformed, officers standing. It will also go a long-way helping the Air Force shift its focus away from traditional Title 10 "organize, train, and equip" responsibilities to a more balanced

focus (and culture) that rightfully embraces warfighting as the essence of its existence.

Summary

In conclusion, this chapter formulated a new paradigm for airpower C2 by explaining the inadequacy of the current "centralized control, decentralized" paradigm to address evolving battlefield C2 requirements and future technology. It then presented a new paradigm, "centralized command, adaptive control, decentralized execution," that aligns better with today's and tomorrow's operations. "Centralized command" provides unity of effort through a single commander responsible and accountable for air power. "Adaptive control" reaffirms that there are no "one size fits all" C2 systems and highlights the need for a wide-variety of options--centralized and decentralized methods to include using mission-orders to empower low-level forces. It also highlights the importance for adequate depth of control. "Decentralized execution" provides subordinates the freedom to act, but only as determined by the commander's guidance and intent. Last, the Air Force should consider adopting the MTO philosophy for its base-line training. Here, MTOs not only serve as the overarching C2 system, but also as a valid "point of departure" when other more centralized types of C2 are needed.

From this report the following recommendations are offered:

1. Adopt "Centralized Command, Adaptive Control, Decentralized Execution" as the new AF paradigm for airpower employment. (47)
2. Develop more flexible/adaptable C2 solutions that provide the JFACC with a "toolbox of capabilities;" this not only includes fixing TACS, but also having structures/C2 elements to provide sufficient depth of control. (8)
3. Consider adopting the MTO philosophy for AF base-line training. (37, 50)
4. Implement an Air Force-wide Warfare Training Strategy. (51)

5. Avoid overly flat C2 structures that increase span of control, increase centralized decision-making, and allows subordinates to drift. (37)
6. Reduce CENTCOM's CFACC duties so they can focus exclusively on warfighting, not on other service-related matters that detract from the joint mission. (19)
7. Build a deployable (or partly deployable) AOC capability. (23)
8. Extend appropriate AF deployments to one-year. (23)
9. Ensure forces train together before deploying into combat. (24)
10. Build a career track to embolden AF warfighting culture. (24)

Glossary

ACCE	Air component coordination element
AEF	Air expeditionary force
AEHF	Advanced extremely high frequency
AETF	Air expeditionary task force
AFDD	Air force doctrine document
AMA	Airspace management authority
AOC	Air operations center
ASOC	Air support operations center
ATO	Air tasking order
AWACS	Airborne early warning control system
BCD	Battlefield coordination detachment
C2	Command and control
C4	Command, control, communications, and computers
CAOC	Combined air operations center
CAS	Close air support
CENTCOM	Central command
CFACC	Combined forces air component commander
COMSATCOM	Commercial satellite communications
CRC	Combined reporting center
DIRSPACEFOR	Director of space forces
DOD	Department of Defense
DOS	Department of State
ETAC	Enlisted terminal air controller
EUCOM	European Command
FAC-A	Forward air controller-airborne
FY	Fiscal year
GBPS	Giga-bytes per second

GPS	Global positioning system
GSU	Geographically separated unit
IW	Irregular warfare
JAGC2	Joint air ground control cell
JAOC	Joint air operations center
JFACC	Joint forces air component commander
JFC	Joint forces commander
JFCOM	Joint Forces Command
JSTARS	Joint surveillance and target attack radar system
JTF	Joint task force
JTAC	Joint terminal air controller
JTRS	Joint tactical radio system
LNO	Liaison Officer
MACCS	Marine air command and control system
MBPS	Mega-bytes per second
MC2A	Multi-command and control aircraft
MILSATCOM	Military satellite communications
MNF-I	Multi-national forces-Iraq
MO	Major operations
MTO	Mission-type orders
NCW	Network-centric warfare
NEAF	Numbered expeditionary air force
OAF	Operation Allied Force
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OODA	Observe, orient, decide, act
PACCOM	Pacific Command
ROE	Rules of engagement
SATCOM	Satellite communications
SOTAC	Special operations terminal air controller
SOUTHCOM	Southern Command

TACC	Tactical air control center
TACP	Tactical air control party
TACS	Theater air control system
US	United States
USAF	United States Air Force
USCENTCOM	United States Central Command
USFK	United States Forces Korea
VoIP	Voice over Internet protocol
VTC	Video tele-conference
WGS	Wideband global satellite communications
WNW	Wideband network waveform
WWII	World war two

Bibliography

Adams, Mike. Theater Air Control System (TACS)—21st Century Challenges. PowerPoint Briefing, 1 May 08.

Air Force Doctrine Document (AFDD) 1. *Air Force Basic Doctrine*, 17 November 2003.

Air Force Doctrine Document (AFDD) 2. *Operations and Organization*, 3 April 2007.

Ayers, Francis H. "Mission-Type Orders and Joint Air Employment Doctrine." Thesis, Carlisle Barracks, 1996.

Barnes, Julian E. "Cyber-Attack on Defense Department Computers Raises Concerns." *Los Angeles Times*, 28 November 2008. http://www.latimes.com/news/nationworld /nation/la-na-cyberattack28-2008nov28,0,06441140.story.

Bolia, Robert S. "Power to the Edge" Book Review. *Air & Space Power Journal* (Summer 2006), http://www.airpower.maxwell.af.mil/airchronicles/bookrev/hayes2.html

Bowman, Mark. USCENTCOM's View on C4 solutions for an Expeditionary Force. To Tactical C4 Conference. PowerPoint Briefing, April 22, 2008.

Boyd, Col John R. "A discourse on Winning and Losing." Briefing, August 1987.

Cartwright, Gen J. e. Vice-Chairman, Joint Chief of Staff. To Deputy Secretary of Defense. Action Memo, 29 September 2008.

Clausewitz, Carl von. *On War*. Edited and translated by Michael Howard and Peter Paret. Princeton, N.J.: Princeton University Press, 1976.

Cohen, Eliot A. *Gulf War Air Power Survey*. Summary Report. Washington, D.C.: US Government Printing Office, 1993.

Congress of the United States. *The Army's Bandwidth Bottleneck*. Washington DC: Congressional Budget Office, August 2003.

Coombs, Howard G, Allan English, and Richard Gimblett. *Networked Operations and Transformation*. Montreal, Canada: McGill-Queen University Press, 2007.

Department of Defense (DOD) Concept. *Joint Operations Concept*, November 2003.

Djuric, Col Terry. "DIRSPACEFOR." Lecture. Air War College, Maxwell AFB, AL, 22 October 2008.

Emerging Cyber Threats Report for 2009. Atlanta, GA: Georgia Tech Information Center,

October 2008.

Evans, Robb. “Marine Corps Air Force Warfighter Talks Findings.” Unpublished report. AF/A5XS, 2008.

Fischer, Michael E. “Mission-Type Orders in Joint Air Operations.” Thesis, Air University, 1995.

Fox news. “Pentagon Cyber Attack—What you need to know.” *Huffington Post*, 21 November 2008. http://www.huffingtonpost.com/2008/11/21/pentagon-cyber.attack_n_ 145581.html.

Gomez, CDR Richard M. “Centralized Command—Decentralized Execution: Implications of Operating in a Network Centric Warfare Environment.” Research Paper, Air University, n.d.

Grinter, Lawrence E, and Barry R. Schneider. *Battlefield of the Future*. Maxwell AFB, AL: Air University Press, 2007.

Habas, Victoria T. “Effective Airspace Management to Facilitate Fires—Establishing an Airspace Management Authority (AMA).” *Air Land Sea Bulletin* no. 2008-3 (September 2008).

Hailes, Ted, Air War College Instructor. Address. Air War College, Maxwell AFB, AL, 20 August 2008.

Heacock, Phillip K. “The Viability of Centralized Command and Control (C2).” *Air University Review*, (January-February 1979). http://www.airpower.maxwell.af.mil/airchronicles/ aureview/1979/jan-feb/heacock.html.

Heflebower, Lt Gen (retired) Charles R. Class Address. Air War College, Maxwell AFB, AL, 18 Nov 2008.

Huntington, Samuel P. *The Soldier and the State: The Theory and Politics of Civil-Military Relations*. New York, NY: Vintage Books, 1964.

Hurd, Lt Gen (retired) Joseph E. Class Address. Air War College, Maxwell AFB, AL, 13 Nov 2008.

“Information Dominance Edges Toward New Conflict Frontier,” *Signal International Journal* 48, no. 12, August 1994, 37.

“Integration of Airpower in Operational Level Planning Report.” USAF/A9 Lessons Learned Report. Washington, DC: 2008.

Jamieson, Perry D. *Lucrative Targets*. Washington, DC: US Government Printing Office, 2001

Joint Publication 1-02. *DOD Dictionary of Military and Associated Terms*. 12 April 2001.

Joint Publication 3.0. *Joint Operations*. 17 September 2006.

Kometer, Lt Col Michael W. *Command in Air War*. Maxwell AFB, AL: Air University Press, 2007.

Lawrence, Brig Gen Susan S. "Using Net-Centric C4 to Win the Long War." USCENTCOM Report, 2007.

Luck, Gen G. and Mike Findlay. "Joint Operations Insights and Best Practices." 2nd ed. Norfolk, VA: US Joint Forces Command, 2008.

Moltke, Field Marshal von. *The Franco-German War of 1870-71*. English version, 1891.

McCann, Carol and Ross Pigeau. *The Human in Command*. New York, NY: Plenum, 2000.

Neil, Curtis. "Joint Air Ground Control Cell." PowerPoint Briefing. ACC/A3F (Joint Air Ground Combat Division), 8 September 2008.

Peterman, Colonel Robert W. "Mission-Type Orders—An Employment Concept for the Future." Unpublished research paper. Carlisle Barracks, PA, 1996.

Rew, Maj Gen William J. "Operational Flexibility." Lecture. Air War College, Maxwell AFB, AL, 25 November 2008.

Short, Lt Gen (retired) Michael C. Class Address. Air War College, Maxwell AFB, AL, 6 November 2008.

Teister, Keith. "Developing More Capable ALO Networks." *Air Land Sea Bulletin* no. 2008-3 (September 2008): 20-24.

United States Strategic Bombing Survey (USSBS), Pacific War, vol. 71, The Fifth Air Force in the War against Japan (War Department: Military Analysis Division, 1947), 24.

"USAF Chief Plans War's Command Chain," *Defense Week*, 2 December 1991, 1.

Van Creveld, Martin. *Command in War*. Boston, MA: Harvard University Press, 1985.

Vego, Milan N. "Operational Command and Control in the Information Age." *Joint Forces Quarterly*, issue 35: 100-107.

Warden, John A. "Air Power for the Twenty-First Century," in Karl P. Magyar, Editor in Chief, *Challenge and Response: Anticipating US Military Security Concerns* (Maxwell AFB, AL: Air University Press, August 1994), 329-330.